BLANKOM®

Professional Headend Solutions

Operating instructions

FM Modulator-Converter

2x FM → 2x FM, S/PDIF (IN/ OUT)

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MCR 221

Part Nº: 9054.01

...Setting Signals

1. Safety and operating instructions

When assembling, starting-up and adjusting the modules, it is necessary to consider the system specific references in the manual instruction.

The modules may only be installed and started up by authorized technical personnel.

When assembling the modules into the receiving points, the adherence of the EMC regulations is to be secured.

The assembly and wiring have to be done without voltage.

All active modules may only be operated with the Headend Controller HCB x00 or Bus Extender BEB x00.

The main voltage and the operating voltage of the modules working by DC have to be in complience to the operating parameters described in the technical data.

With all work the regulations of the DIN EN 50083 have to be considered. Especially the safety relevant execution of the DIN EN 60728-11 [3] is necessary.

WEEE-Reg.-N° DE 50389067

2. Device variants

MCR 221	9054.01	2x FM [87,5 ... 108 MHz] → 2x FM [87,5 ... 108 MHz], S/PDIF (IN/ OUT)

Minimum software requirements for Headend Controller HCB x00:

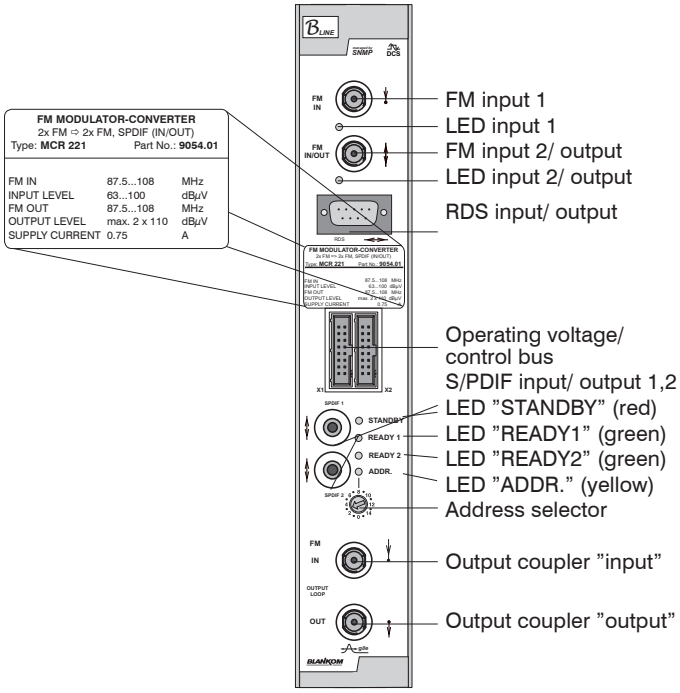
9650.03:	version 2.34 [1]
9650.04/.05:	version 3.18 [1]
9652.01:	version 3.23 [1]
9653.01:	version 3.27 [1]
9653.02:	version 3.28 [1]

[1] Updates: www.blankom.de

3. General

The FM Modulator-Converter MCR 221 is a module of the head end system B-LINE, which is conceived as a complete system for middle sized networks. The module converts terrestrial FM radio channels into the FM cable frequency range.
All the components are programmed via a central control unit and will function independently thereafter. The status of the modules are displayed via LED's (see chapter 7.2 "Status LED's").

4. Front view



FM input 1
LED input 1
FM input 2/ output
LED input 2/ output
RDS input/ output
Operating voltage/ control bus
S/PDIF input/ output 1,2
LED "STANDBY" (red)
LED "READY1" (green)
LED "READY2" (green)
LED "ADDR." (yellow)
Address selector
Output coupler "input"
Output coupler "output"

gile

DCS

managed by
SNMP

5. Functional description

The MCR 221 includes two low-noise receivers with large signal immunity for terrestrial FM signals with a frequency range from 87.5 MHz to 108 MHz and an output modulator for two FM channels in the same frequency range. The functions of the module are: amplification, selection, shift in the frequency range and level adjustments alignment of two of one or two receive antennas delivered terrestrial FM signals to prepare them for feeding into two FM cable channels. The input signals are demodulated and additionally they can be taken out the two RCA jacks as S/PDIF signal. The MCR 221 uses the Sub-D socket to output the received RDS data. Furthermore, the MCR 221 can be used as a double FM modulator with S/PDIF inputs. The RDS data are added either statically via the HCB x00 or dynamically via the Sub-D socket.
The signal processing is based on the principle of double-superhet to avoid image frequency interferences. After a highly-selective range filtering and a input fader the input signal goes to an extremely low noise, while high sound performance PHEMT amplifier. The following PHEMT mixer guarantees excellent intermodulation behavior in the first IF range. The first oscillator is constructed in fractional-N synthesizer technology, and thus guarantees a low phase noise. After selection and amplification, the signal passes to the second mixer, in which the standard IF of 10.7 MHz is generated. A quartz generator is used for both channels together as the oscillator. The further signal processing (selection, demodulation, stereo decoding and RDS separation) of the two IF signals is done digitally using a DSP. Separated from the DSP RDS and audio data streams are transported to the modulator FPGA. In the FPGA 2 full digital FM modulators are implemented. Here the audio signals are subjected of a 19-kHz filtering. It's be done the stereo processing: addition or subtraction of the audio signals and their modulation on the 38-kHz carrier. A 19-kHz pilot tone and RDS data are added to the audio signal. Then, the thus generated MPX signal is FM-modulated. The FM signals are combined, subjected to a D/ A conversion and are available via a directional coupler or directly at the output of the module. Each FM channel is individually generated and independently configurable.
Radio text plus (+ RT) is passed by the board of the receiving source to the receiver.

6. Adjustments

6.1 Adjustment with the Headend Controller

- Adjustment of the addresses at the Bus Extender BEB x00 and at the modules
- Activation of the programming mode on each module by selecting the line (BEB x00) and the module position (01... 15) at the Headend Controller (HCB x00)
  → yellow LED illuminates until the beginning of the parameter adjustment
- Adjustment of the MCR 221 parameters (see chapter 9) → green LED is switched on
- After the programming the MCR 221 will be automatically switched into the operating mode
  → yellow LED flashes shortly/ green LED is switched on

The manual instructions of the Headend Controller HCB x00 and the Bus Extender BEB x00 have to be considered.

6.2 Adjustment with the PC/ laptop

· Remote programming requires an “online connection” according the IP standard and an ethernet connection at the PC/ laptop
· Adjustment of the line/ position addresses at the Bus Extender BEB x00 as well as at the modules
· At the Headend Controller HCB x00 input IP address (default: 192.168.2.80)
· For “direct connection” between a PC and HCB x00 use crossover cable (RJ 45)
· For connection over a hub use a normal straight throught patch cable
· Start-up HTML browser and put in IP address as target address
· If connected correctly the web interface will be opened on the pc and a blue LED (LINK) at the HCB x00 will be lit up.
· All adjustments of the modules are specified on the web interface.

6.3 Adjustment with SNMP

· The SNMP functionality requires the use of HCB x00 with enabled SNMP software option CKB 100.
· SNMP version 1.0 [4] is supported.
· Automatic creation of the MIB based on the current head end configuration by the HCB x00.
· For setting and reading out the parameters and to receive traps from an SNMP management additional software is required.
· Further notes on the SNMP functionality of BLANKOM modules are listed in the SNMP manual.

7. Meaning of the LED‘s

7.1 LED’s at the FM input ports

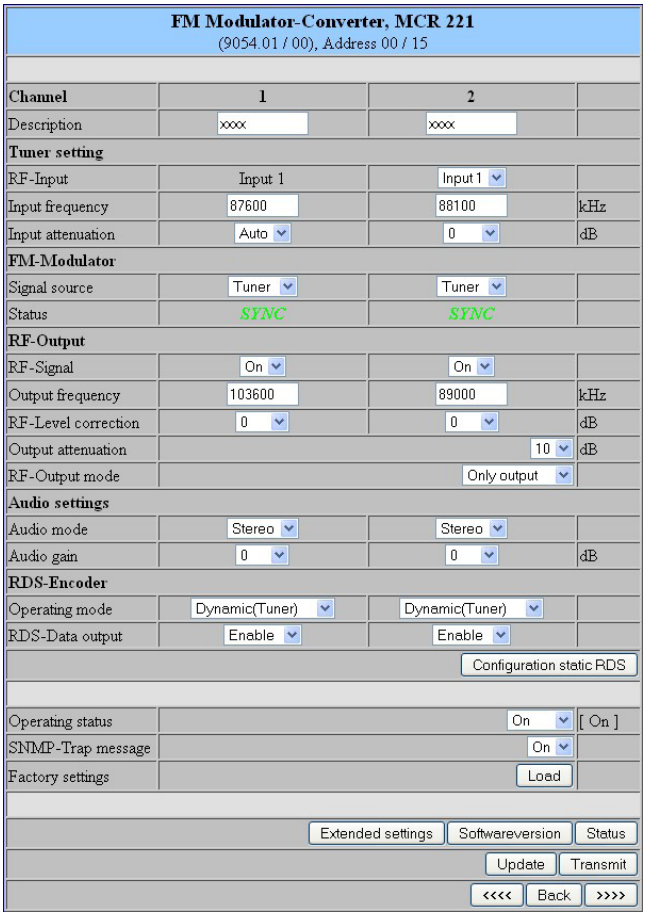
Colour	Status	Meaning of display
green	permanently on	FM port is configured as input.
yellow	permanently on	FM port is configured as output.

7.2 Status LED’s

Designation (Colour)	Status	Meaning of display
STANDBY (red)	permanently on	module is in standby
	flashing	module faulty (hardware error)
READY 1 (green)	permanently on	FM modulator 1 working properly, input signal is synchronized
	flashing	error warnings, depending on signal: FM modulator 1 not synchronized on input (e.g. there is no input signal)
READY 2 (green)	permanently on	FM modulator 2 working properly, input signal is synchronized
	flashing	error warnings, depending on signal: FM modulator 2 not synchronized on input (e.g. there is no input signal)
ADDR (yellow)	illuminated/ flashing	remote control connection/ data being exchanged

8. Programming by web server (via HCB x00) [1]

8.1 Main menu



Name of device, item number, address in head end

Channel displays parameters for channel 1 or 2
Description channel name, editable (max. 30 characters)

Tuner settings
RF input [2] channel 1: input 1 (fixed)
channel 2 selection: input 1, input 2 [3]
Input frequency adjustment range: 87500 ... 108000 kHz
Input attenuation selection: Auto [4], 0 ... 31 dB

FM-Modulator
Signal source input signal source, selection: Tuner, S/PDIF
Status this displays whether there is **SYNC**hronisation or **noSYNC**hronisation at the input of the modulator

RF-Output
RF-Signal selection: On, Off
Output frequency adjustment range: 87500 ... 108000 kHz
RF-Level correction adjustment range: +3 …-3 dB in 0.5-dB steps (per channel)
Output attenuation adjustment range: 0 … 31 dB in 1-dB steps (module)
RF-Output mode selection: Loop through, Only output

Audio settings
Audio mode selection: Mono, Mono1, Mono2, Stereo
Audio gain adjustment range: +6 ... -10 dB in 0.5-dB steps

RDS-Encoder
Operating mode selection: Off, Dynamic (Tuner), Dynamic (External), Static
RDS-Data output selection: Enable, Disable
Routing to the adjustment menu: configuration static RDS (see menu 3)

Operating status selection: On, Off, reset
SNMP-Trap mess. selection: On, Off; if SNMP option in HCB x00 enabled, otherwise “locked“ displays
Factory settings setting the default values (see menu 2)

Routing to the respective adjustment menus:

Extended settings see menu 1
Status see menu 4
Software versions see menu 5

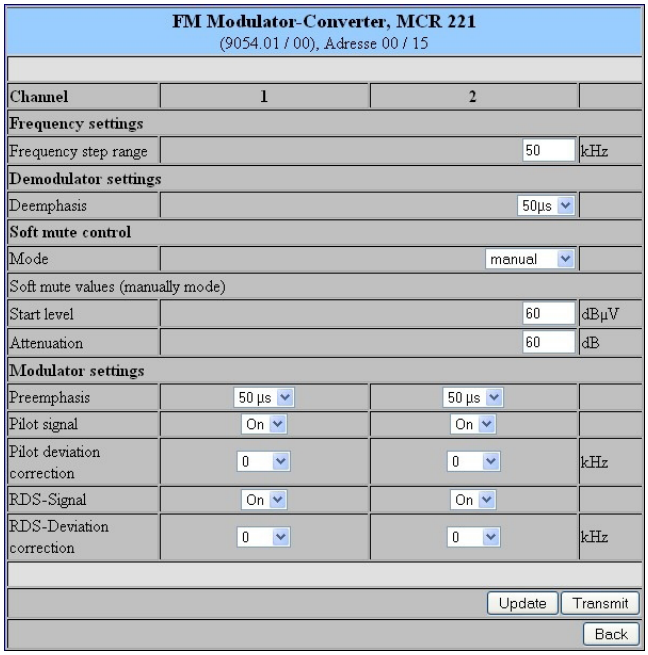
[2] input 1 and 2 about 11 dB input attenuation (directional coupler)

[3] When input 1 assigned as the source of the channel 2, the FM port 2 is configured automatically as output..

[4] S/N max. 58 dB CCIR weighted

[1] For further details see the HCB manual

8.2 Extended settings (menu 1)



Name of device, item number, address in head end

Channel displays the adjustments of channel 1 or 2

Frequency settings
Frequency step range: input of the raster for setting the input and output frequency, range: 1 ... 500 kHz

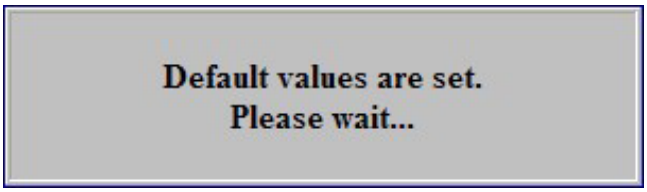
Demodulator settings
Deemphasis: selection: 50 µs, 75 µs, Off

Soft mute control
Mode: selection: manual, automatic
Soft mute values (manually mode)
Start level: input in dBµV
Attenuation: input in dB

Modulator settings
Preemphasis: selection: 50 µs, 75 µs, Off
Pilot signal: selection: On, Off
Pilot deviation corr.: adjustment range: +2 ... -2 kHz in 0.1-kHz-steps
RDS-Signal: selection: On, Off
RDS-Deviation corr.: adjustment range: +2 ... -2 kHz in 0.1-kHz-steps

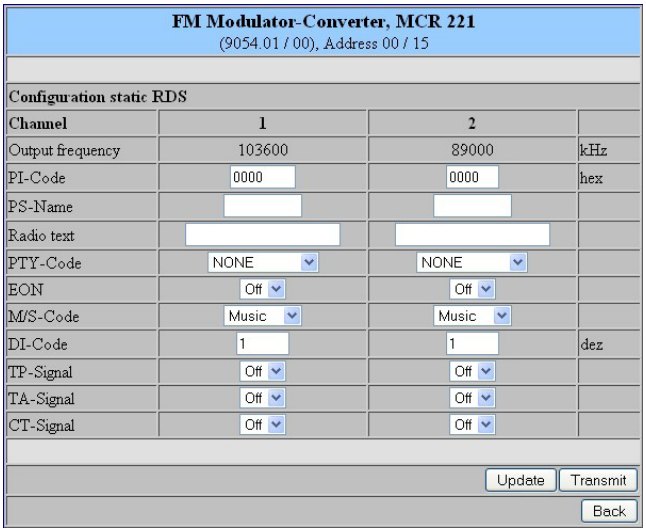
8.3 Factory settings (menu 2)

When this menu item is requested, at first a security query whether it really set all parameters to the factory default settings pops up.



Affirming the query, all settings stored in the EEPROM will be deleted and replaced by the default settings (see chapter 9). The module will go back to these default values.
Once the setting process is over, there will be an automatic return to the main menu. It takes about one minute.

8.4 Configuration of static RDS (menu 3)

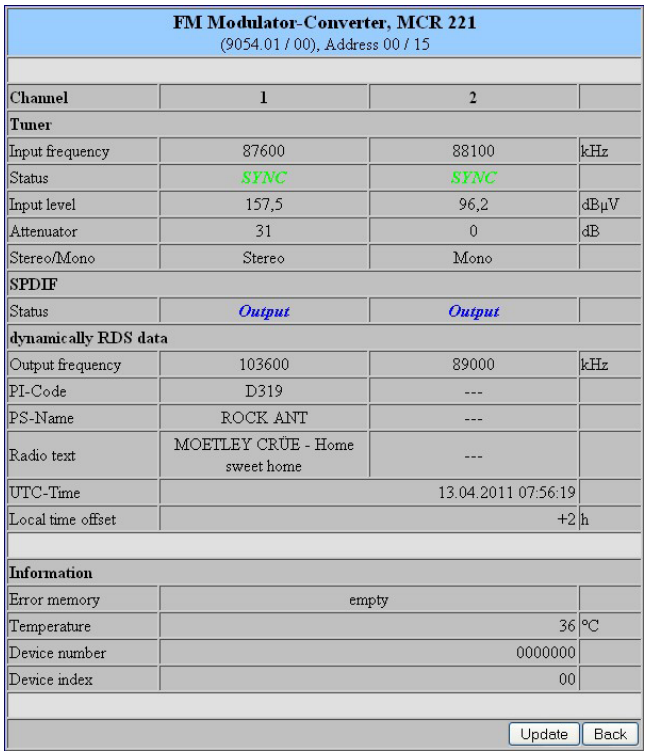


Name of device, item number, address in head end

Configuration static RDS
Channel displays the settings for the FM output channel 1 and 2
Output frequency: displays the frequencies set for the FM channel (in kHz)
PI-Code: adjustment range: 0000 … FFFF (hex.) [1]
PS-Name: 8 characters of the name of the transmitted program or service
Radio text: max. 64 characters, which can be transmitted statically
PTY-Code: selection of the program type
EON: selection: On, Off
M/S-Code: selection: music, language
DI-Code: Decoder-Identifikations-Control code, entered decimally, default setting: 1 (stereo)
TP-Signal: selection: On, Off
TA-Signal: selection: On, Off
CT-Signal: selection: On, Off

[1] The current list of PI codes for German radio broadcasters can be found on the following website: www.irt.de./de/themengebiete/digitaler-hoerfunk/radio-daten-system-rds.html

8.5 Device status (menu 4)



FM Modulator-Converter, MCR 221
(9054.01 / 00), Address 00 / 15

Channel	1	2	
Tuner			
Input frequency	87600	88100	kHz
Status	*SYNC*	*SYNC*	
Input level	157,5	96,2	dBµV
Attenuator	31	0	dB
Stereo/Mono	Stereo	Mono	
SPDIF			
Status	*Output*	*Output*	
dynamically RDS data			
Output frequency	103600	89000	kHz
PI-Code	D319	---	
PS-Name	ROCK ANT	---	
Radio text	MOETLEY CRÜE - Home sweet home	---	
UTC-Time	13.04.2011 07:56:19		
Local time offset	+2		h
Information			
Error memory	empty		
Temperature	36		°C
Device number	0000000		
Device index	00		

Update Back

Name of device, item number, address in head end

Channel displays status information of both channels

Tuner

Input frequency displays in kHz

Status status of synchronization of the demodulator

Input level displays in dBµV

Attenuator displays in dB

Stereo/ Mono audio mode of the receiving signal

SPDIF

Status S/PDIF status display: status of synchronization, if used as an input or displays, if it used as an output

dynamically RDS data

Output frequency displays in kHz

PI-Code displays the sender's PI code

PS-Name displays the service name

Radio text displays the radio text

UTC-Time displays the UTC time putted out by RDS

Local time offset displays the offset betwen local and UTC time

Information

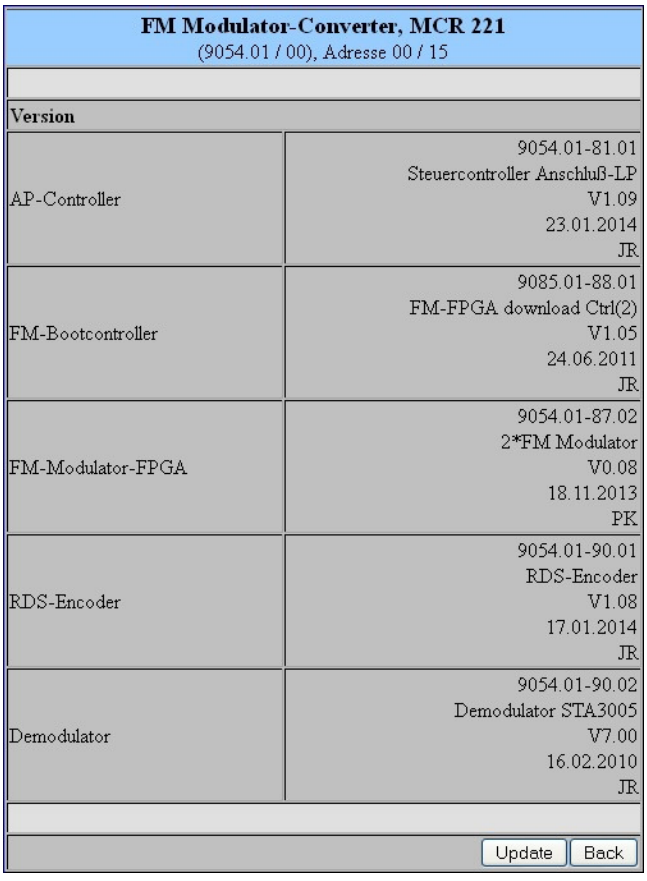
Error memory displays the errors arising in internal communication between the controllers

Temperature displays the temperature of the device

Device number displays the device number

Device index displays the device index

8.6 Software overview (menu 5)



FM Modulator-Converter, MCR 221
(9054.01 / 00), Adresse 00 / 15

Version	
AP-Controller	9054.01-81.01 Steuercontroller Anschluß-LP V1.09 23.01.2014 JR
FM-Bootcontroller	9085.01-88.01 FM-FPGA download Ctrl(2) V1.05 24.06.2011 JR
FM-Modulator-FPGA	9054.01-87.02 2*FM Modulator V0.08 18.11.2013 PK
RDS-Encoder	9054.01-90.01 RDS-Encoder V1.08 17.01.2014 JR
Demodulator	9054.01-90.02 Demodulator STA3005 V7.00 16.02.2010 JR

Update Back

Name of device, item number, address in head end

Software versions
displays the software versions for the controllers as follows:

Controller of the front circuit board

Boot controller of the FM modulator FPGA

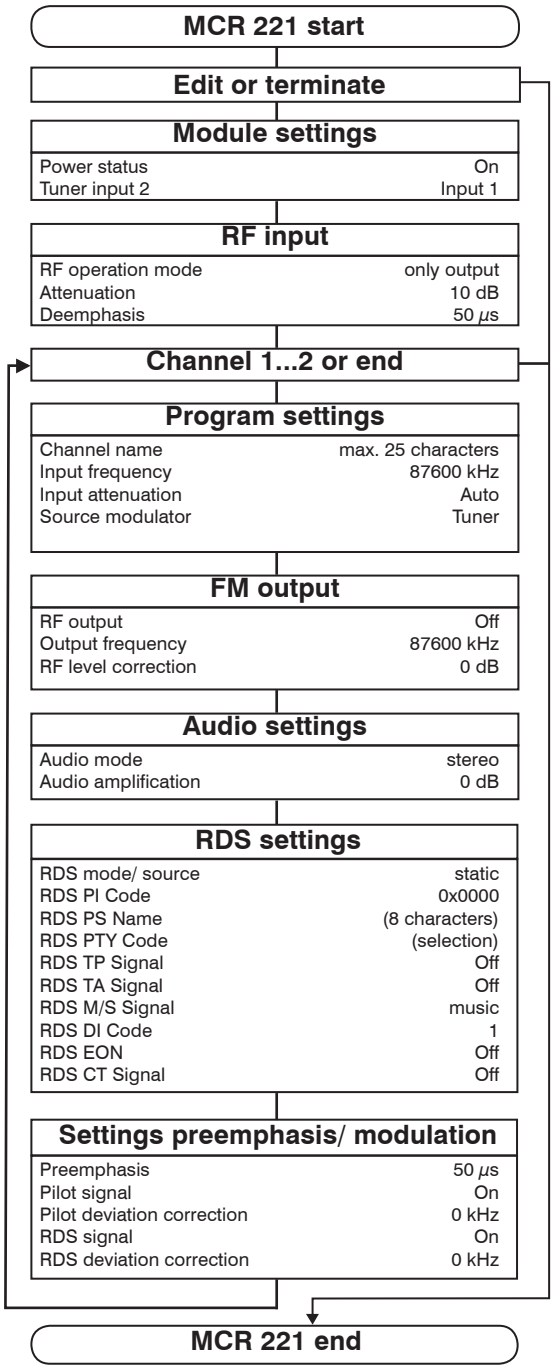
FM modulator FPGA

RDS encoder

Demodulator

9. Manual menu control at the Headend Controller (HCB x00)

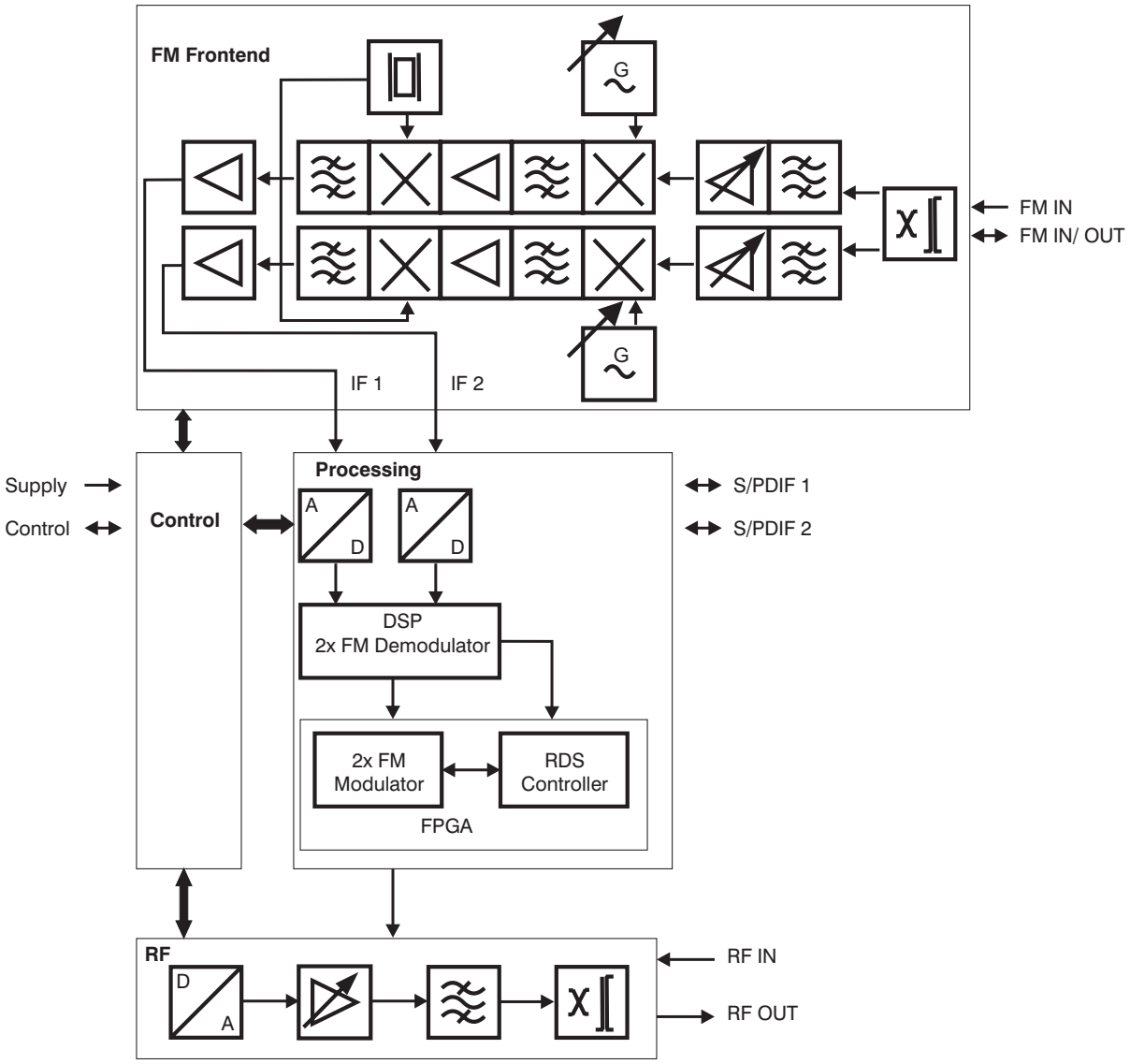
The values in the blocks setting are the default values. After pushing the button “default“ settings on the main page, all settings stored in the EEPROM are erased and reset to default values. The device is set to these values again (see also chapter 8.3).



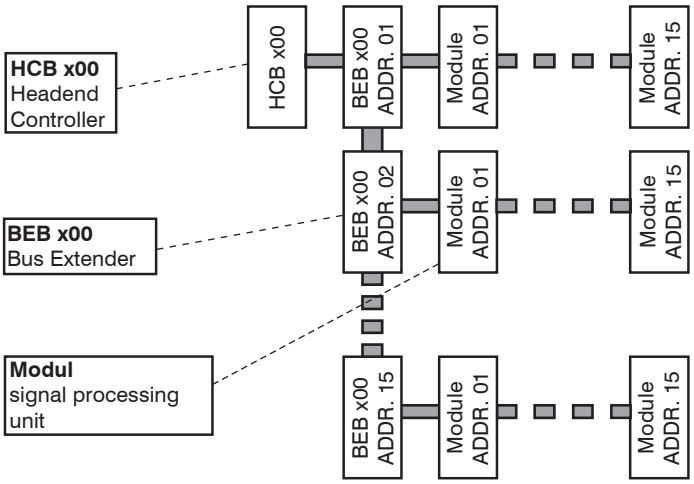
10. Trap messages

Item	Message	Type	Explanation
01	Signal OK	INFORMATION	Module works correctly
02	Input not sync	WARNING	Input is not synchronized
03	System reset	WARNING	Reset after internal error
04	Power fail	CRITICAL	Error on supply voltage
05	ATMEGA: Open Error	CRITICAL	Access error FM boot controller
06	NIOS: Open Error	CRITICAL	Access error RDS encoder

11. Block diagram



12. Head end bus structure

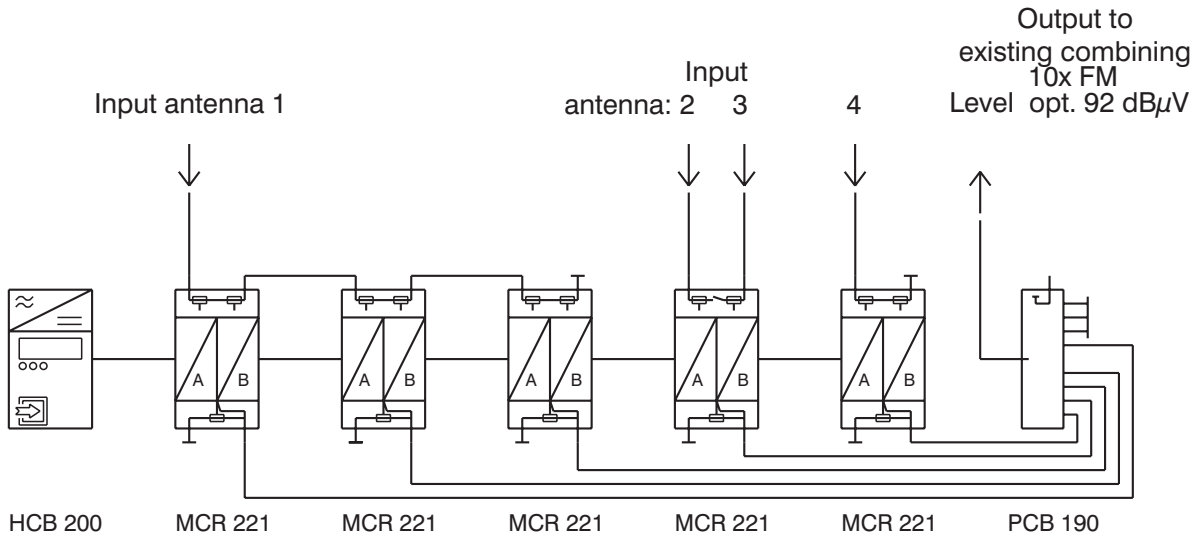


The number of the possible module connections (00 ... 15) to a BEB x00 depends on the total power consumption of this line.

13. Application example

Integration in existing B-LINE configuration

Conversion of 10 FM programs into the cable network



14. Technical data

FM demodulator/ FM input	
Input frequency range	87.5 ... 108.0 MHz
Setting range for tuning interval	1 ... 500 kHz
Level range (for signal noise ratio ≥ 58 dB)	63 ... 100 dBµV [1]
Muting threshold	≤ 19 dBµV [1]
Return loss	≥ 14 dB
Mono/ stereo threshold	≤ 30 dBµV [1]
Impedance	75 Ω
Connector	F socket
Directional coupler through loss	< 2 dB
Time delay at co-channel operation ($f_i = f_o$)	≤ 5 ms
FM modulator/ FM output	
LF input	2x S/PDIF according EN 60958 [1]
Max. FM deviation	75 kHz
LF level range (deviation correction)	-10…+6 dB
Frequency range	87.5…108 MHz
Setting range for tuning interval	1 ... 500 kHz
Output impedance	75 Ω
Output return loss	> 16 dB
Amplitude response 40 Hz...15 kHz, reference 400 Hz, preemph. 50 µs	< ± 0.5 dB
Rejection of modulation frequencies between 18.9…19.1 kHz and 23…100 kHz	> 40 dB
Total harmonic distortion between	
40 Hz…15 kHz at 40 kHz deviation	> 66 dB at 400 Hz
40 Hz…15 kHz at 75 kHz deviation	> 60 dB at 400 Hz
Difference-tone-attenuation D2 betw. 40 Hz…15 kHz	> 70 dB
SNR weighted (pre- and deemphase 50 µs, R, L)	> 66 dB (Quasi-Peak-Detector, CCIR weighted)
SNR unweighted (pre- and deemphase 50 µs, R, L)	> 72 dB (Quasi-Peak-Detector, CCIR unweighted)
Cross-talk attenuation in range	
40 Hz…100 Hz	> 38 dB (- 26 dBFS)
100 Hz…15 kHz	> 40 dB (- 26 dBFS)
Output frequency drift after 24 hours at 25 °C	< ± 2 kHz
Temperature depended frequency drift	< ± 2 kHz
Spurios between	
47…87.5 MHz and 111…862 MHz	≥ 64 dB
87.5…111 MHz	≥ 60 dB
Nominal frequency error	≤ 3 kHz
Output level (switchable)	
direct output (w/o direct. coupler)	max. 2x 110 dBµV
with directional coupler	max. 2x 100 dBµV
Total level step	1 dB (0…31 dB)
Individual level step	0.5 dB (± 3 dB)
Connector	F socket
Stereo coder	
Processing	Multiplex, CCIR
Pilot deviation	6.7 kHz
RDS coder	
Processing	EN 62106:2001 [2]
Deviation	2.4 kHz
Supported services	PS, PTY, TP, TA, EON, PI, RT, MS, CT, DI
In-/ output accord. UECP V 6.02 [5]	D-SUB 9-pole
Operating parameters	
Current/ voltage	12 V (± 0.2 V)/ 750 mA
Residual ripple of supply voltage	≤ 10 mV_{pp}
Enviromental conditions	
Temperature range	-10 ... +55 °C
Temperature range for data keeping	5 ... 45 °C
Relative humidity	≤ 80 % (non condensing)
Method of mounting	vertical
Location of mounting	splash-proof and drip-proof
Miscellaneous	
Dimensions (l x w x h)	
without 19” adapter	50 x 276 x 148 mm
with 19” adapter	50 x 301 x 148 mm
Weight	1,200 g
Delivery content	
1x Bus connector	
2x F connecting cable 140 mm	

[1] FM IN/ OUT used as FM input 2

15. Bibliography

[1] EN 60958-1: Digital audio interface - Part 1: General (IEC 60958-1:2008); German version EN 60958-1:2008
-3: Digital audio interface - Part 3: Consumer applications (IEC 60958-3:2006 + A1:2009); German version EN 60958-3:2006 + A1:2010
-4: Digital audio interface - Part 4: Professional applications (IEC 60958-4:2003 + A1:2008); German version EN 60958-4:2003 + A1:2008

[2] EN 62106:2001 : Specification of the radio data system (RDS) for VHF/ FM sound broadcasting in the frequency range from 87.5 to 108.0 MHz (IEC 62106:2000); German version

[3] EN 60728-11: Cable network for television signals, sound signals and interactive services Part 11: safety (IEC 607278-11: 2005). German version EN 60728-11: 2005

[4] RFC 1157 Request for Comments (RFC): RFC Database; url: http://www.rfc-editor.org/rfc.html

[5] SPB 490: UECP-DS Universal Encoder Communication Protocol, Final version 6.02, September 2006-Copyright RDS Forum, Geneva (Switzerland)

[6] EN 50083-2: Cable networks for television signals, sound signals and interactive services Part 2: Electromagnetic compatibility for equipment, German version EN 50083-2:2006

16. Glossary

AM	**A**mplitude **m**odulation
AP	**A**nschluss**p**latte (front circuit board)
ASI	**A**synchronus **S**erial **I**nterface
ATV	**A**nalog **T**ele**v**ision
AV	**A**udio/ **V**ideo
CCIR	**C**omité **C**onsultatif **I**nternational **R**adiocommunication
CT	**C**lock **T**ime
C/N	**C**arrier to **N**oise ratio
D/A	**D**igital/ **A**nalog
DI	**D**ecoder-**I**dentification-Control code
DIN	**D**eutsches **I**nstitut für **N**ormung (German standards institute)
DSP	**D**igital **s**ignal **p**rocessor
DVB	**D**igital **V**ideo **B**roadcasting (-C Cable, -S Satellite, -S2 Satellite 2, -T Terrestial)
EN	**E**uropäische **N**orm (European standard)
EON	**E**nhanced **O**ther **N**etwork
ETSI	**E**uropean **T**elecommunications **S**tandards **I**nstitute
FIFO	**F**irst **I**n–**F**irst **O**ut
FM	**F**requency **m**odulation
FPGA	**F**ield **P**rogrammable **G**ate **A**rray
HTTP	**H**yper**t**ext **T**ransfer **P**rotocol
ID	**Id**entifier
IF	**I**ntermediate **F**requency
IIC	**I**nter-**I**ntegrated **C**ircuit (I^2C bus, data bus within module)
IP	**I**nternet **P**rotocol
LED	**L**ight **E**mitting **D**iode
MC	**M**icro**c**ontroller
MIB	**M**anagement **I**nformation **B**ase
MPEG	**M**oving **P**icture **E**xperts **G**roup
MS	**M**usic/ **S**peech
NIM	**N**etwork **I**nterface **M**odule
PCR	**P**rogram **C**lock **R**eference
PI	**P**rogram **I**dentification
PID	**P**rogram **Id**entifier
PLL	**P**hase **L**ocked **L**oop
PMT	**P**rogram **M**ap **T**able
PS	**P**rogram **S**ervice Name
PTY	**P**rogram **Ty**pe
RDS	**R**adio **D**ata **S**ystem
RF	**R**adio **F**requency
RT	**R**adio **T**ext
SNMP	**S**ingle **N**etwork **M**anagement **P**rotocol
S/PDIF	**S**ony/**P**hilips **D**igital **I**nter**f**ace
SPI	**S**erial **P**eripheral **I**nterface
SPTS	**S**ingle **P**rogram **T**ransport **S**tream
TA	**T**raffic **A**nnouncement
TP	**T**raffic **P**rogram
TS	**T**ransport **S**tream
UTC	**U**niversal **T**ime **C**oordinated

17. Document history

Version	Date	Modification	Author
1.00	06.09.2011	basic document	Häußer
1.01	04.03.2014	revision (extended settings, technical data)	Häußer

Options available upon request. Subjects to changes due to technical progress.

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CE Declaration of Conformity

Manufacturer: BLANKOM Antennentechnik GmbH
Hermann – Petersilge – Straße 1
07422 Bad Blankenburg
Germany

Product Name: FM Modulator-Converter

Type Name: MCR 221

Type N°: 9054.01

BLANKOM Antennentechnik GmbH confirms that the mentioned product meets the guideline(s) of the Council for the approximation of legislation of the member states.

Electromagnetic compatibility (2004/ 108/ EC)
The following standards are met: DIN EN 50083-2: 2007-04 (EN 50083-2:2006-06)

Low voltage guideline (2006/ 95/ EC)
The following standards are met: DIN EN 60950-1: 2006-04 (EN 60950-1:2006-11)
Information technology equipment -Safety-

Restriction of hazardous substances (2011/ 65/ EC)
The following standards are met: DIN EN 50581: 2013-02 (EN 50581:2012)

Bad Blankenburg, Germany, 2011-11-23

Dr. Piero Kirchner
(Managing Director)